RESOLVE AVIONICS
Kennedy Space Center (KSC)
Request for Information (RFI)

NNK14ZMS003L

NASA Kennedy Space Center is hereby issuing a Request for Information (RFI) for the purpose of seeking sources and soliciting information from private industry on **Payload Avionics Systems and Avionics Elements to be used in a short duration lunar surface resource prospecting mission.** This document is for information and planning purposes and to allow industry the opportunity to verify reasonableness and feasibility of the requirement, as well as promote competition.

This RFI is used solely for information planning purposes and does not constitute a solicitation. In accordance with FAR 15.201(e), responses to this RFI are not offers and cannot be accepted by the Government to form a binding contract. The Government is under no obligation to issue a solicitation or to award any contract on the basis of this RFI. The information provided in responses to this RFI will not be made public in an effort to protect any propriety company information. Nonetheless, respondents should clearly and properly mark any propriety or restricted data contained within its submission so it can be identified and protected. Respondents are solely responsible for all expenses associated with responding to this RFI. Responses to this RFI will not be returned, and respondents will not be notified of the result of the review.

Potential vendors should review all documents; a summary of the information is as follows:

The Vendor would provide information on either a complete payload avionics system, or elements of such a system, that can survive the demands of a short duration mission to the surface of the moon's South Pole. Environmental factors to be considered for such a mission include low doses of radiation, single event upsets, extended temperature ranges, vacuum, and regolith dust. Additionally, the payload avionics system must withstand all of the induced loads of launch, transit, decent to and roving on the lunar surface. Performance under these environmental extremes should be fully considered, however due to this project's Class D classification, acceptance of higher-risk/lower-tolerance designs may be considered. Also, while only radiation tolerant designs will be considered, a total ionizing dose requirement has not been set. Due to the mission duration however, it is expected that lower TID tolerances (5 to 30 kRAD) may be allowed.

The payload avionics system should exist in one of three possible physical forms comprised of three separate elements in various configurations with various levels of integration possible. The three elements to be considered include a Science Payload Computer (SPC), a LAVA Data Processing Module (LDPM), and an OVEN Data Processing Module (ODPM). These elements may be packaged separately (Option B2), as single unit (Option C2), or as an SPC with a combined LDPM and ODPM (Option C1).

The SPC element will provide the *core* Avionics functionality, acting as the primary data processor, data storage, and task sequencer for the payload. Additionally, the SPC will be responsible for providing switched 28V power to each of the payload subsystems while providing feedback and control to several critical thermal system components. A tentative set of SPC related requirements is captured in the specifications section.

The LDPM and ODPM are not considered part of the *core* avionics subsystem; however they extend the overall avionics responsibilities to cover the remaining functionality of two payload subsystems, LAVA and OVEN. The LAVA subsystem includes multiple analytical instruments, a camera, and a manifold with components typical of a temperature controlled fluid system. The OVEN subsystem on the other hand, is mostly mechanical in nature. With the addition of a camera, it is characterized by a collection of motion control components typical of a robotic system. A tentative set of LDPM and ODPM interfaces required to fully operate these two subsystems is summarized in the following specifications section.

SPC Specifications

General Processing Requirements

Processor Speed: The minimum processor speed has not been set, however current NASA-led software development efforts have shown success at a speed of 1GHz. Responses to this RFI should clearly indicate processor speed.

Operating System Support: The SPC should provide a board support package capable of supporting the Linux Operating System.

Data Storage: The minimum data storage requirement has not be set. Responses to this RFI should clearly state their maximum storage capabilities.

Rover-to-SPC/Payload Interfaces

Power: The Rover will provide two 28VDC power feeds, BUS A and BUS B, to the payload through the SPC. BUS A will act as the main power feed. Bus B will be dedicated to survival heater components of the SPC-controlled thermal management system.

Data: The Rover will communicate with the Payload through the SPC using RS-422.

SPC-to-Subsystems Inputs and Outputs

The SPC is expected to provide the following inputs from and outputs to payload subsystems. The quantities listed in the below table include spare.

I/O Type	Qty	Notes
28V On/Off (Bus A) Power Outputs, 1Amp	12	Overcurrent Protection, Current Sensing, and Voltage Sensing required for all channels
28V On/Off (Bus A) Power Outputs, 10Amp	5	Overcurrent Protection, Current Sensing, and Voltage Sensing required for all channels
28V (Bus B) Power Outputs, 1Amp	9	Fused channels only, capable of being operated when BUSA is not powered.
28V (Bus A) PWM Power Outputs, 1Amp	24	PWM should operate at approximately 100Hz..
1kΩ Platinum RTD/PRT Inputs	46	2 Wire, Class A RTD's. Any drive currents should be maintained at or below a constant 1mA

Table 1 – SPC-to-Payload I/O

SPC-to-Subsystems Communication

The SPC is expected to require the following channels for communicating to the various payload subsystems. The quantities listed in the below table include spare.

Comm Type	Qty	Notes
RS422	15	
Controller Area Network (CAN), 1Mbit/s	1	Not Typical for Spacecraft, may require NRE Not Required for Option C2
Controller Area Network (CAN), 125kbit/s	1	Not Typical for Spacecraft, may require NRE
Ethernet	1	Not Typical for Spacecraft, may require NRE
USB	1	Not Typical for Spacecraft, may require NRE

Table 2 – SPC-to-Payload Comm.

LDPM Specifications

SPC-to-LDPM/Payload Interfaces

Power: The LDPM will operate from a single 28V 10-Amp power feed, supplied by the SPC.

Communication: The LDPM will communicate with the SPC via the 1Mbit CAN bus.

LDPM Inputs and Outputs

The LDPM is expected to provide the following inputs from and outputs to the LAVA subsystem. The quantities listed in the below table include spare.

I/O Type	Qty	Notes
28V On/Off Power Outputs, 8 Amp	2	Overcurrent Protection, Current Sensing, and Voltage Sensing required for all channels
28V On/Off Power Outputs, 2 Amp	3	Overcurrent Protection, Current Sensing, and Voltage Sensing required for all channels
28V PWM Heater Power Outputs, 2Amp	32	PWM should operate at approximately 100Hz. Overcurrent Protection required for all channels.
PWM Power Output to Peltier Cooler	1	Vmax = 15.9V, Imax = +/-6.1A (Bidirectional) PWM should operate at up to 3kHz. Overcurrent Protection, Current and Voltage Sense required.
Latching Valve Control Output, type 1	20	Pulsed Power, +/- 7A for 2milliseconds, Bidirectional (Open/Close)
Latching Valve Control Output, type 2	4	Pulsed Power, +/- 28V for 10 milliseconds, Bidirectional (Open/Close)
Proportional Valve	1	Current Controlled, 0-66mA
Bridge Type Pressure Transducer Inputs	13	10V Excitation, 75mV Full Scale Output, 0.1 PSIA Resolution
1kΩ Platinum RTD/PRT Inputs	50	2 Wire, Class A RTD's. Any drive currents should be maintained at or below a constant 1mA

Table 3 – LDPM I/O

ODPM Specifications

SPC-to-ODPM/Payload Interfaces

Power: The ODPM will operate from a single 28V 10-Amp power feed, supplied by the SPC.

Communication: The ODPM will communicate with the SPC via the 1Mbit CAN bus.

ODPM Inputs and Outputs

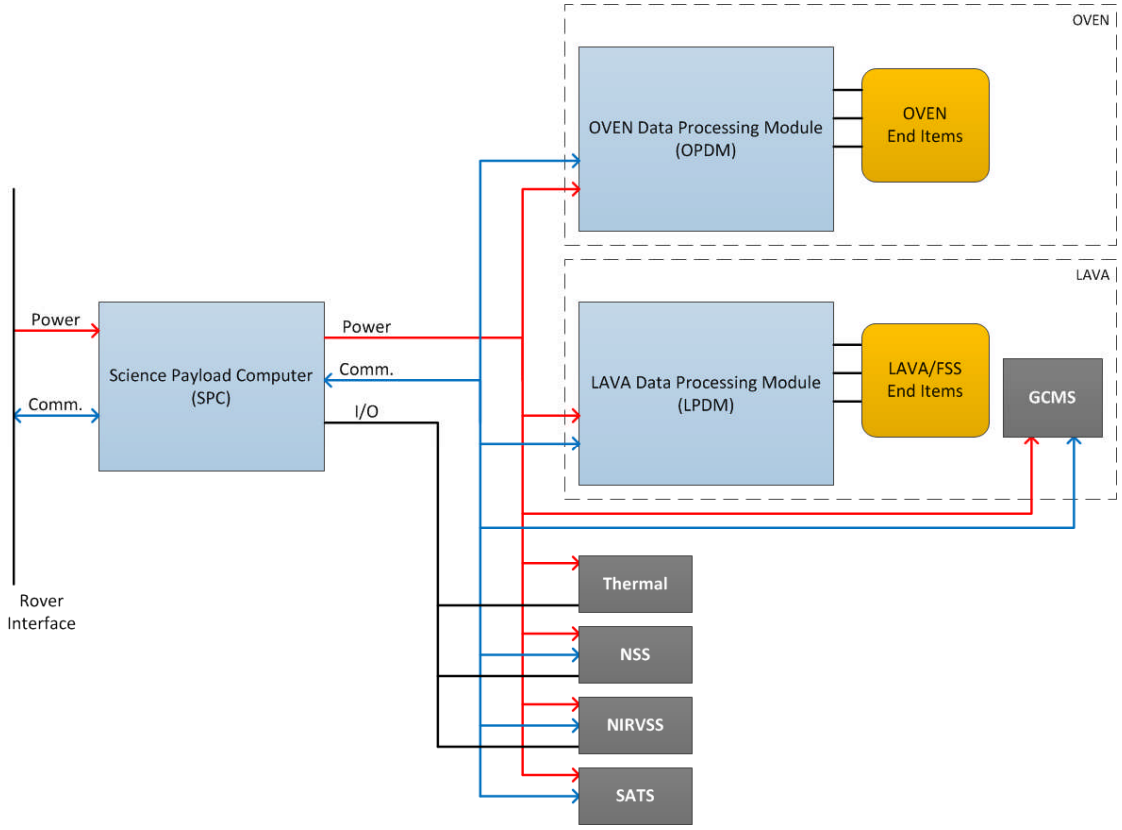
The ODPM is expected to provide the following inputs from and outputs to the OVEN subsystem. The quantities listed in the below table include spare.

I/O Type	Qty	Notes
28V On/Off Power Outputs, 2 Amp	1	Overcurrent Protection, Current Sensing, and Voltage Sensing required for all channels
28V PWM Heater Power Outputs, 3 Amp	4	PWM should operate at approximately 100Hz. Overcurrent Protection required for all channels.
28V PWM Heater Power Outputs, 2 Amp	7	PWM should operate at approximately 100Hz. Overcurrent Protection required for all channels.
Thermocouple Inputs, Type K	36	May require cold junction compensation.
Bipolar Stepper Motor Control Outputs	8	Two Phase, Current Mode, Full step, 28V, up to 2A
Rotary Solenoid Control Outputs	3	28V Latching, Maximum Pulse = 1 second
Linear Solenoid Control Outputs	3	28V PWM at up to 25 Hz
Resolver Inputs	4	2Vrms-12Vrms at 10kHz, Accuracy > +/-60 arc-min
Potentiometers Inputs	4	500Ω
Bridge Type Load Cell Inputs, 100 gram	1	Excitation = 1-10V, Rated Output = 2mV/V, Resolution = +/-1 gram
Bridge Type Load Cell Inputs, 500 lb.	4	Excitation = 1-18V, Rated Output = 2mV/V, Resolution = +/-1 lb
Limit Switch Inputs	11	

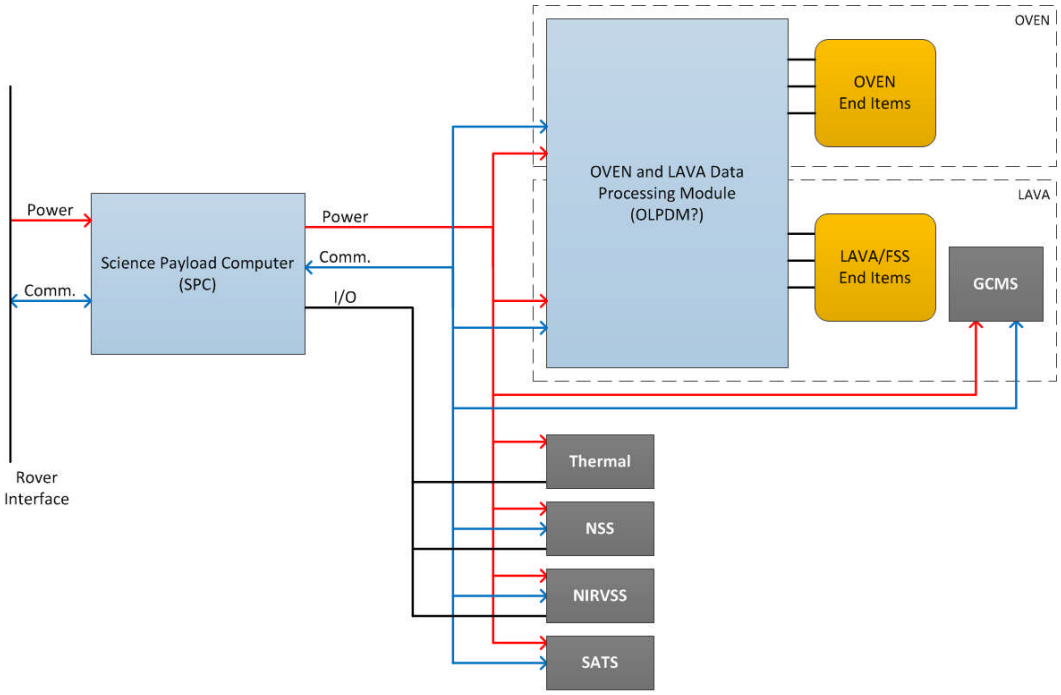
Table 4 – ODPM I/O

Hardware Architecture Options

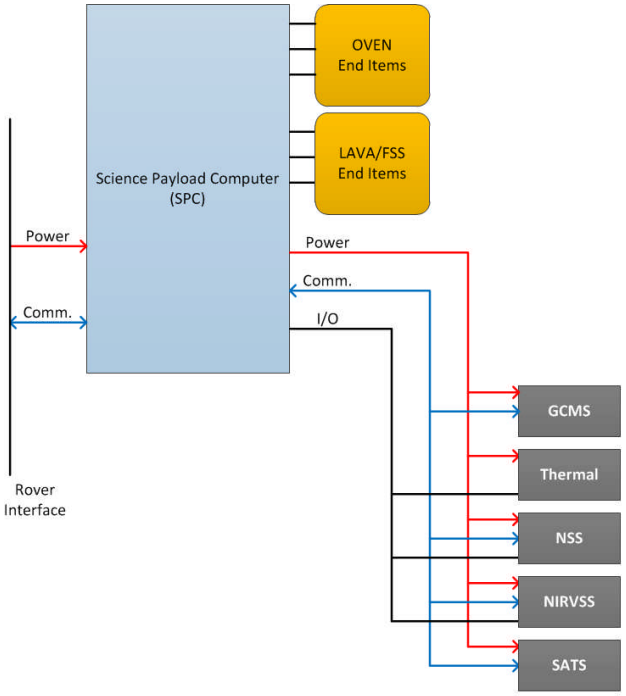
As discussed above, the payload avionics requirements may be fulfilled with a variety of physical implementations. The following section lays out the three approaches currently under evaluation; with each approach, B2, C1, and C2 offering various levels of hardware integration. Currently, Option B2 is the preferred approach, with options C1 and C2 being considered for their potential space, weight, and power (SWaP) performance improvements.



Architecture – Option B2



Architecture – Option C1



Architecture – Option C2

Responders to this RFI are encouraged to comment on any or all of the foregoing and to express their interest for any proposed acquisition by submitting the following information:

1) Lead Times – Describe typical lead times required for hardware procurement, assembly and testing.

2) The Vendor will specify any support, material, equipment, and/or permitting needed from NASA.

3) The Vendor should indicate any Requirements noted in this RFI that cannot be met with their capabilities. Should also indicate what needs to be provided by NASA so they can meet those requirements.

4) The Vendor should indicate which components of any proposed system currently exists as COTS, or slightly modified COTS. If significant NRE will be required to design or develop any new components of a proposed system, the Vendor shall identify these components as a "NEW DESIGN".

5) The Vendor should explain any other proposed methods/capabilities they feel would meet or closely compare to the NASA Requirements based on their expertise/experience.

6) Cost: Although not mandatory for responding to this RFI, NASA requests the Vendor provide a ROM (Rough Order of Magnitude) cost estimate for this effort that can be used to develop budgetary forecasting. This information will be secured as proprietary information and not retained as a quote or for any potential procurement that may or may not be realized in the future.

6) Qualification and/or Flight Heritage: Although not required for responding to this RFI, NASA requests the vendor provide details on any previous qualification efforts or reports pertaining to any or all components used in their proposed design. This may include any tests, analyses, certifications, or specific flight history pertaining to a particular component (or system).

RESOLVE AVIONICS
Kennedy Space Center (KSC)
Request for Information (RFI)

NNK14ZMS003L

Vendors having the capabilities necessary to meet or exceed the stated requirements are invited to submit appropriate documentation, literature, brochures, and references. The vendor will be required to submit documentation demonstrating their Company's core competencies (skill, knowledge, expertise, and vessels) and brief examples of past performance building similar equipment. Response to the RFI shall be limited to no more than 20 pages. Please advise if the requirement is considered to be a commercial or commercial-type product. A commercial item is defined in FAR 2.101.

All responses to this RFI shall be submitted to Christopher Zuber, no later than 4:00PM EST June 20, 2014. Please use reference number NNK14ZMS003L in any response. The response may be sent as one printed hardcopy or electronically as single Microsoft Word .doc and/or Microsoft EXCEL .xls file for each response. Any referenced notes may be viewed at the following URLs linked below.

In addition to whatever information the responder chooses to provide, each RFI response shall include a cover sheet with the following information:

1. RFI Solicitation Number and Title
2. Responding Organization (including address, POC and phone number)
3. A brief synopsis of the RFI response in less than 20 words
4. Section number your response is addressing
5. Potential partnerships (industry, international, US government agencies)
6. Whether your company would be available for a site visit

Additional information to be added as applies:

Responses must include the following: name and address of firm, size of business; average annual revenue for past 3 years and number of employees; ownership; whether they are large, or any category of small business*, number of years in business; affiliate information: parent company, joint venture partners, potential teaming partners, prime contractor (if potential sub) or subcontractors (if potential prime); list of customers covering the past five years (highlight relevant work performed, contract numbers, contract type, dollar value of each procurement; and point of contact - address and phone number).

NASA Clause 1852.215-84, Ombudsman, is applicable. The Center Ombudsman for this acquisition can be found at http://prod.nais.nasa.gov/pub/pub_library/Omb.html.

The solicitation and any documents related to this procurement will be available over the Internet. These documents will reside on a World Wide Web (WWW) server, which may be accessed using a WWW browser application. The Internet site, or URL, for the NASA/KSC Business Opportunities home page is http://prod.nais.nasa.gov/cgi-bin/eps/bizops.cgi?gr=D&pin=76 It is the offeror's responsibility to monitor the Internet cite for the release of the solicitation and amendments (if any). Potential offerors will be responsible for downloading their own copy of the solicitation and amendments, if any.